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Torio et al.

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(54) **CLOUD-HOSTED INTERFACE FOR PORTABLE DEVICE COMMUNICATORS**

(71) Applicant: **FISHER-ROSEMOUNT SYSTEMS, INC.**, Round Rock, TX (US)

(72) Inventors: **Michelle Diane Bautista Torio**, Manila (PH); **Jasmin Velasco Alcazaren**, Imus Cavite (PH)

(73) Assignee: **FISHER-ROSEMOUNT SYSTEMS, INC.**, Round Rock, TX (US)

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(52) **U.S. Cl.**
CPC ***G05B 19/0426*** (2013.01); *G05B 2219/25066* (2013.01); *G05B 2219/25124* (2013.01)

(58) **Field of Classification Search**
CPC G05B 19/0426; G05B 2219/25124; G05B 2219/25066
See application file for complete search history.

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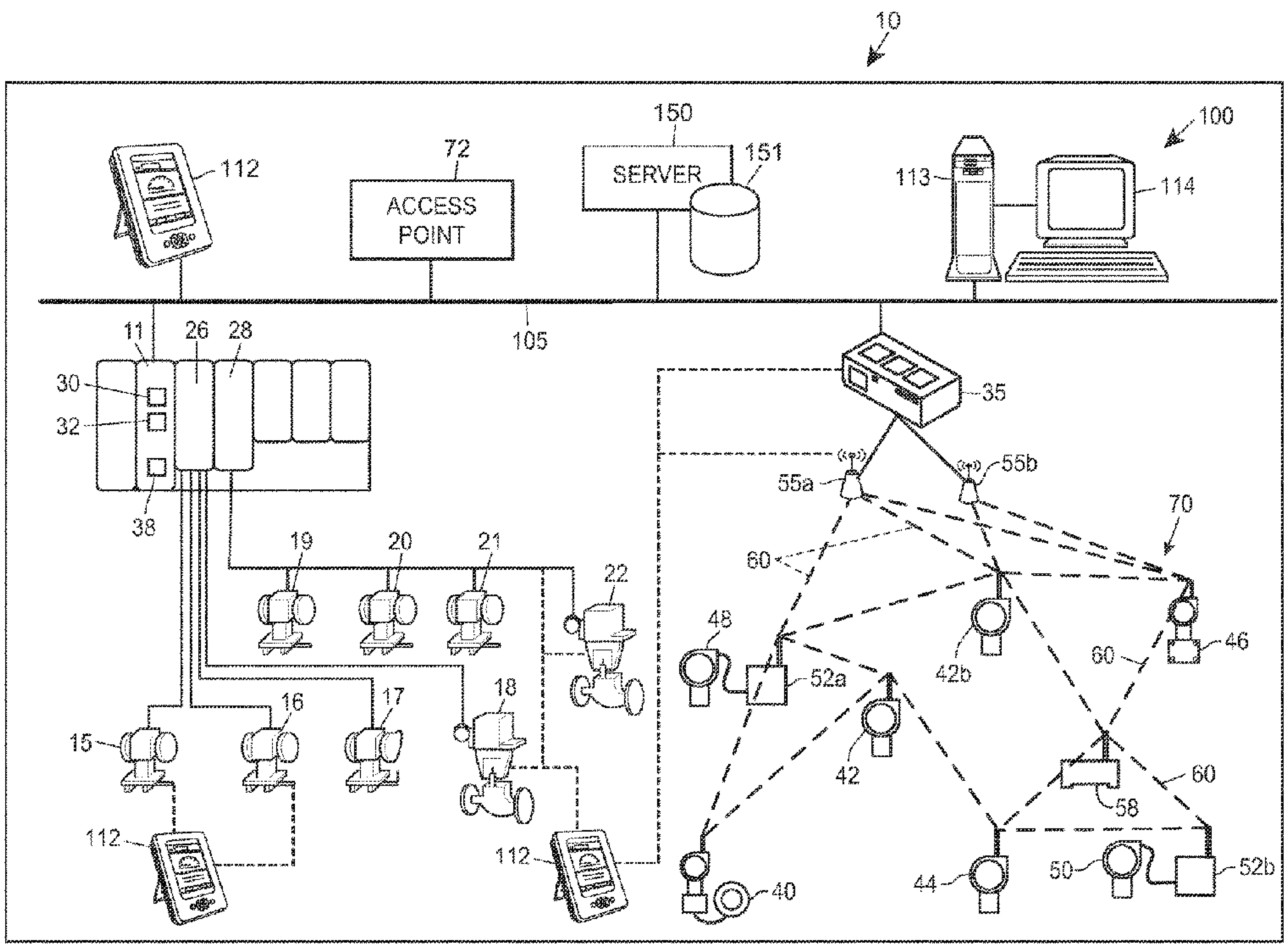
Primary Examiner — Mohammad Ali
Assistant Examiner — Sheela Rao
(74) *Attorney, Agent, or Firm* — Marshall, Gerstein & Borun LLP

(57) **ABSTRACT**

A system for sharing plant device configuration data collected by handheld communicators during monitoring and servicing activities. Plant device configuration data is assigned relational identifiers such as equipment identifiers that provide additional information relevant to the configuration data for a plant device. Additional plant process identifiers may also be assigned to distinguish configuration profiles for various equipment sets. The relational data may be used to retrieve the configuration profiles for application in various efforts to replicate configurations across plants.

26 Claims, 11 Drawing Sheets



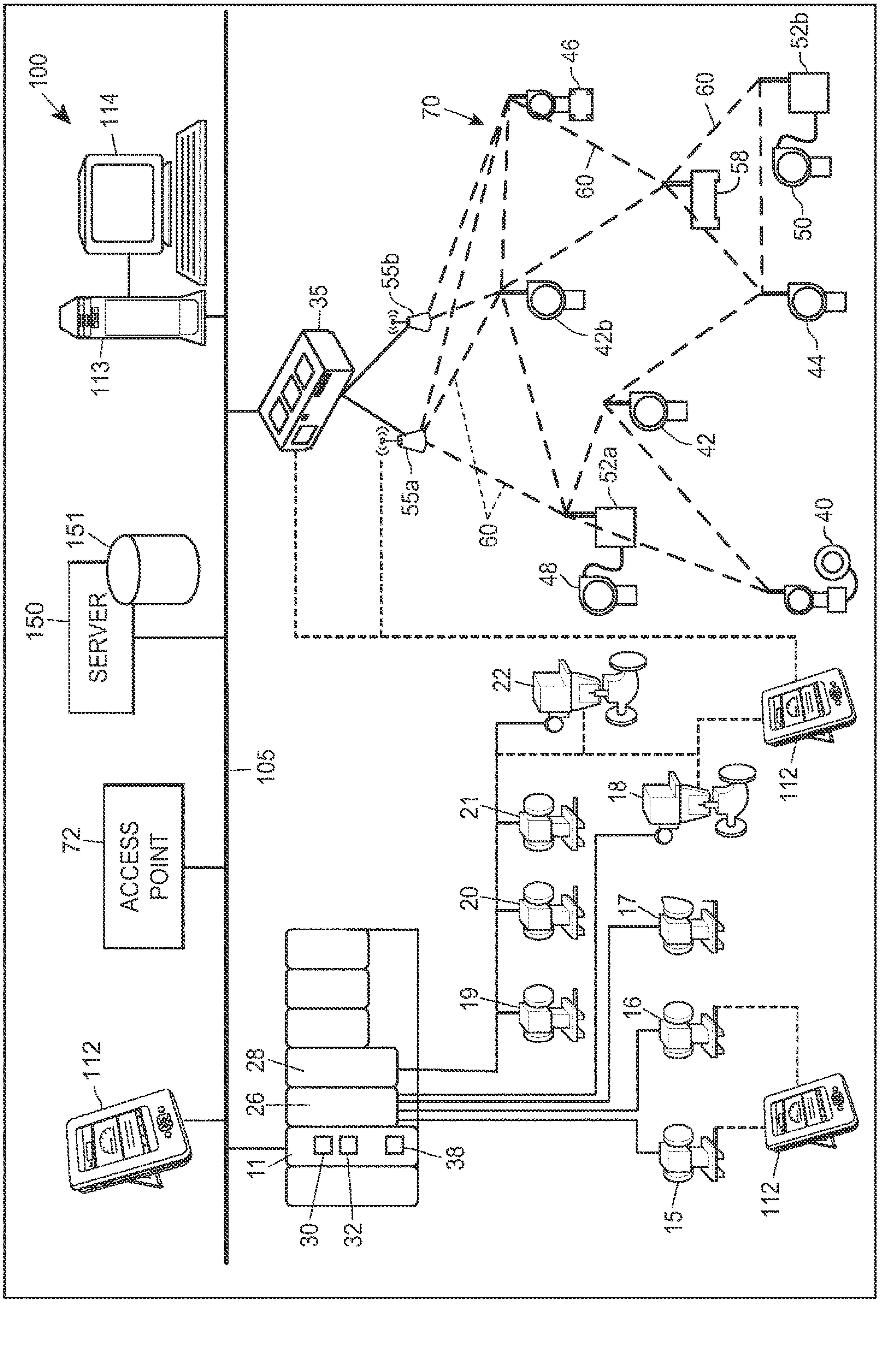

10
100
114
113
ACCESS POINT
72
SERVER
150
151
105
112
11
26
28
30
32
38
35
55a
55b
70
60
58
52a
52b
46
50
42
42b
44
40
48
15
16
17
18
19
20
21
22

Fig. 1

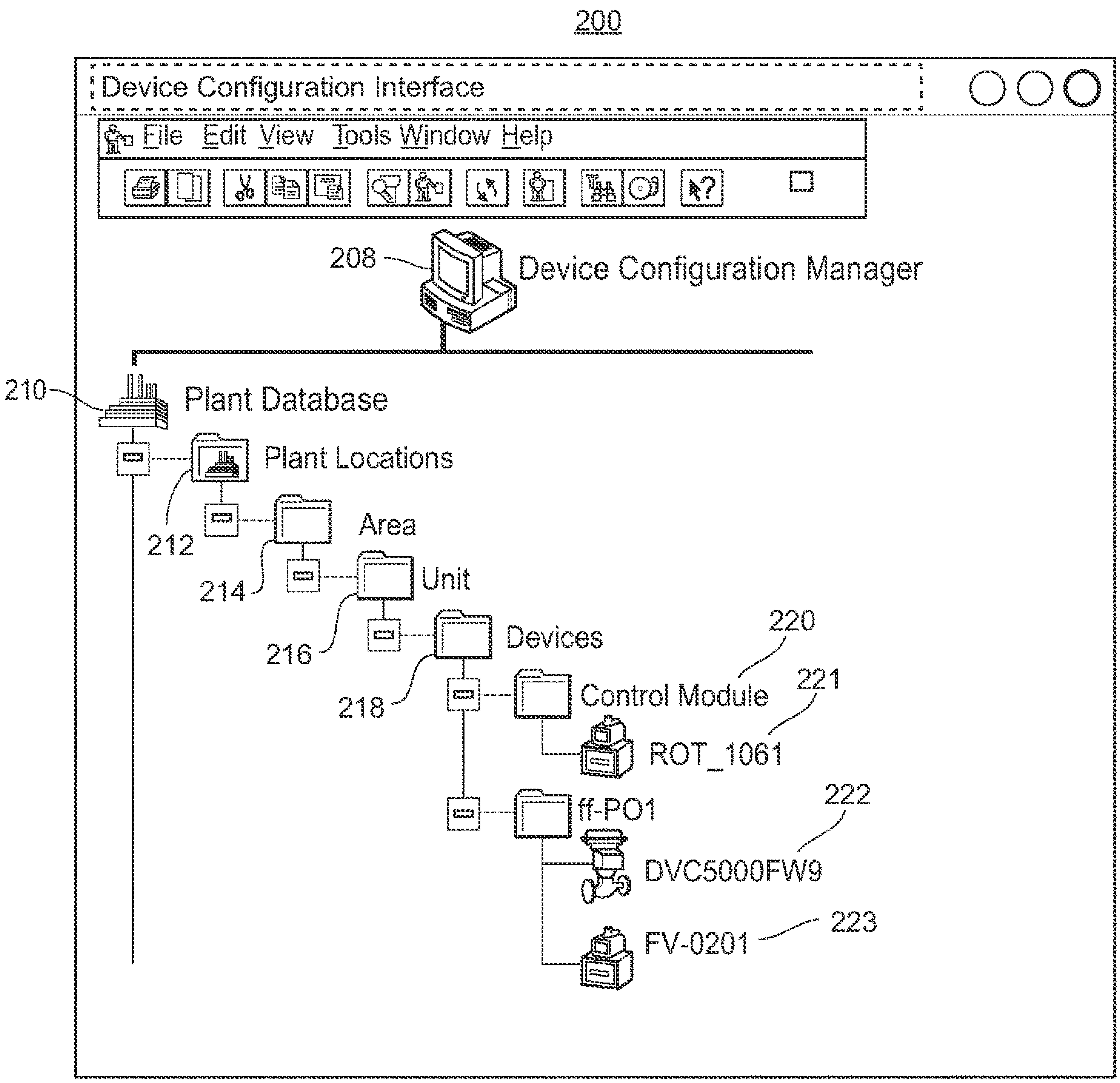

200
Device Configuration Interface
File Edit View Tools Window Help
208
Device Configuration Manager
210
Plant Database
Plant Locations
212
Area
214
Unit
216
Devices
218
220
Control Module
221
ROT_1061
ff-PO1
222
DVC5000FW9
FV-0201
223

Fig. 2

Device Configuration

300

Tag: PT-101 310
Device Type: 3051 312
Manufacturer: Rosemount
114 Variables

Printed on: 9/14/2017 10:23:03 PM

Parameter	Value
# of Remote Seals	None
(150:Variable)	16 - Unknown Enum...
(152:Variable)	0x00
Alarm Direction	High
Alarm/Sat Type	User
Alert Mode	Off
Analog Output	4.001
BurstMode	On
Burst Option	*****
Calibration Type	Diff (DP)
CM Lower Value	0.0000
CM Units	DEFLT
CMUpper Value	0.9999
CM xf fnct	Linear
CMV	0.0000
Date	5/10/2013
Description	SYNC
Dev flags	0x00
Device Status	0x40
Distributor	Rosemount
Drain Vent Material	316 SST
Electronics S/N	6613968
Fact trm recal loc	*****
Field Device Revision	7
High Alarm	Silicone oil
High Alarm	16
High Alert Value	23.00
High Alert Value	23.00
High Sat	7.212
High Saturation	80.0
Isolator Material	20.80
Local ZERO / SPAN...	20.80
Low Alarm	316 SST
Low Alarm	Enable
Low Alert Value	3.73
Low Alert Value	3.73
Low Sat	-0.014
Low Saturation	-40.0

Parameter	Value
Message	AUTOSYNC
Meter type	Alt custom Eng unit
Minimum Span	0.00606
Model	3051
Model Number 1	3051S2CD2A2E12A...
Model Number 2	
Model Number 3	Std coplanar (C)
Model Configuratio...	25.4
Model Temperature	degC
Model Temperature	Bad Value
Not applicable	5
Num req preams	PTFE
O-Ring Material	0.005
Percent of Range	Bell 202 current
Physicl signl code	0
Polling Address	Installd
Press Alert	0.000
Pressure	0.60
Pressure Damping	0.000
Pressure Input 1	9.016
Pressure Input 2	On
Pressure Process AL...	psi
Pressure Units	Scaled Variable*
Primary Variable	Coplanar
Process Connection	316 SSt
Process Connection...	None
RS Fill Fluid	None
RS isolator Material	None
RS Seal Type	Installd
scaled available	0.000000
Scaled Output 1	1.000000
Scaled Output 2	-0.00081
Scaled Output 1	Sensor Temperature
Scaled Variable	4
Select dec pt pos	2
Sensor Serial Numb...	6613968
Software Revision	8
star	*

Fig. 3A

Lower Calibration Po...	3.90
Lower Range Value (...	3.90
Lower Range Value (...	0.000
Lower Sensor Limit	Bad Value
Lower Sensor Limit	-1.00000
MAnufacturer	Rosemount
Measurement	Diff (DP)

314

Status group 1	0x00
Status group 2	0x00
Status group 3	0x00
Status group 4	0x00
Status group 5	0x00
SV Cutoff Mode	Off
SV index used	1
SV Linear Offset	0.000
Parameter	**Value**
SV Low Flow Cutoff	0.00000
SV max index	1
SV Transfer Functio...	Linear
SV Units	DEFLT
SV Units	*DEFLT
Tag	PT-101
Temp Alert	Installd
Temp available	Installd
Third Variable	Selected Variable*
Transfer Function	Linear
Transmitter S/N	2908492
Units of Measure	*DEFLT
Universal Revision	5
Upper Calibration Po...	9.016
Upper Range Value (...	Bad Value
Upper Range Value (...	0.99995
Upper Sensor Limit	Bad VAlue
Upper Sensor Limit	1.00000
Variable(s)	0v05
Write Protect Status	Off

Fig. 3B

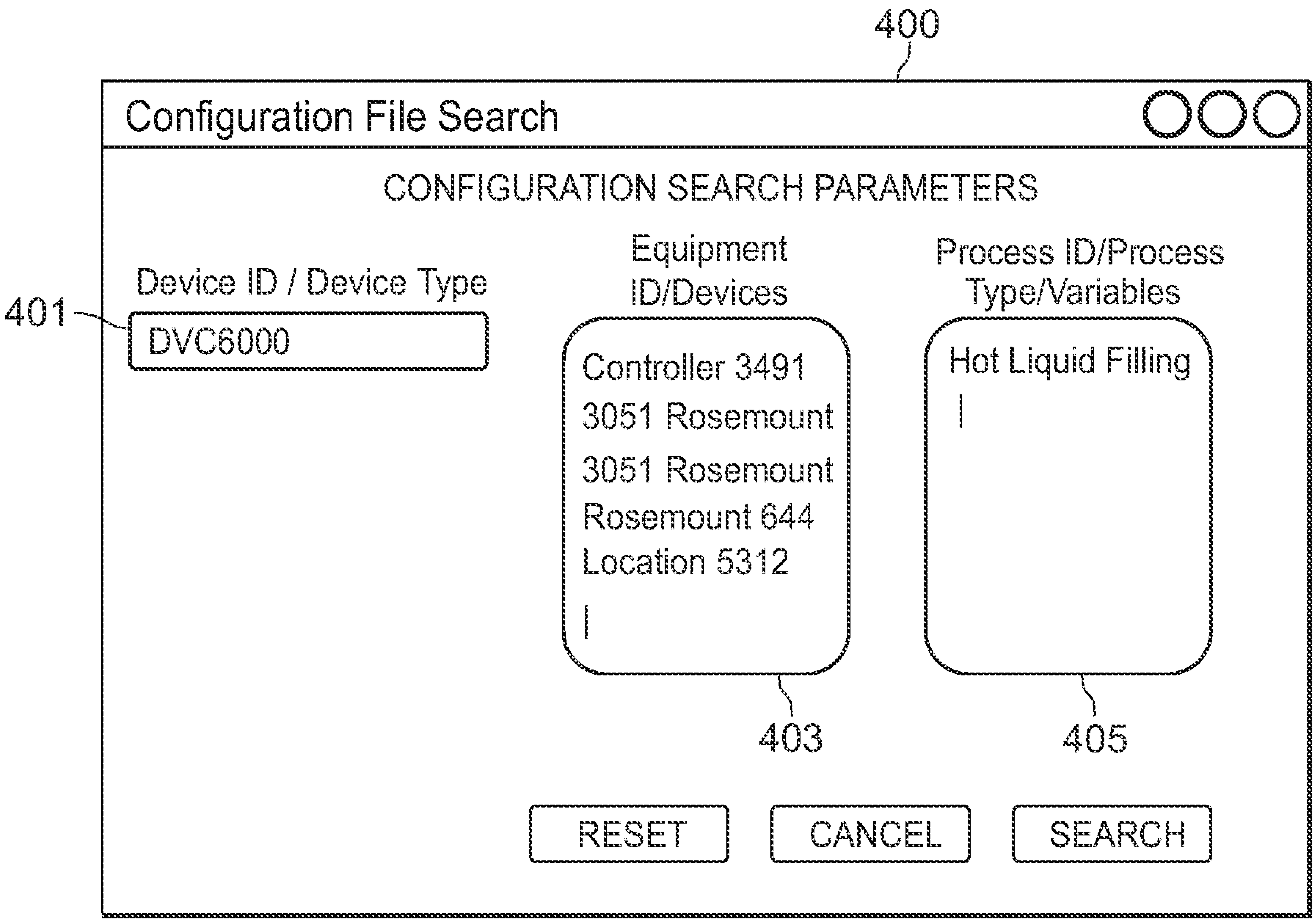

400
Configuration File Search
CONFIGURATION SEARCH PARAMETERS
Device ID / Device Type
401
DVC6000
Equipment ID/Devices
Controller 3491
3051 Rosemount
3051 Rosemount
Rosemount 644
Location 5312
403
Process ID/Process Type/Variables
Hot Liquid Filling
405
RESET
CANCEL
SEARCH

Fig. 4

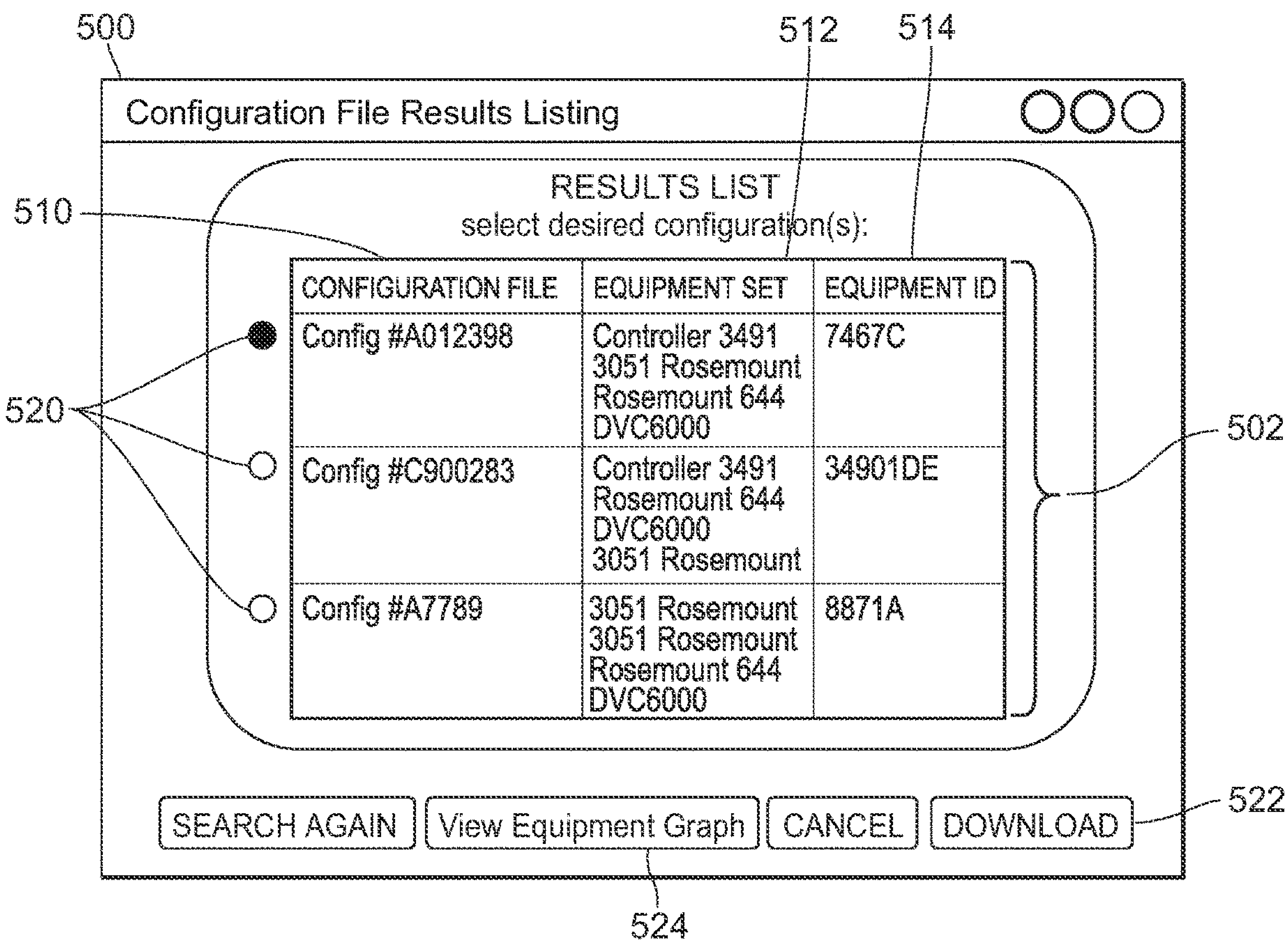

500
512
514
Configuration File Results Listing
RESULTS LIST
select desired configuration(s):
510
CONFIGURATION FILE
EQUIPMENT SET
EQUIPMENT ID
Config #A012398
Controller 3491
3051 Rosemount
Rosemount 644
DVC6000
7467C
520
502
Config #C900283
Controller 3491
Rosemount 644
DVC6000
3051 Rosemount
34901DE
Config #A7789
3051 Rosemount
3051 Rosemount
Rosemount 644
DVC6000
8871A
SEARCH AGAIN
View Equipment Graph
CANCEL
DOWNLOAD
522
524

Fig. 5

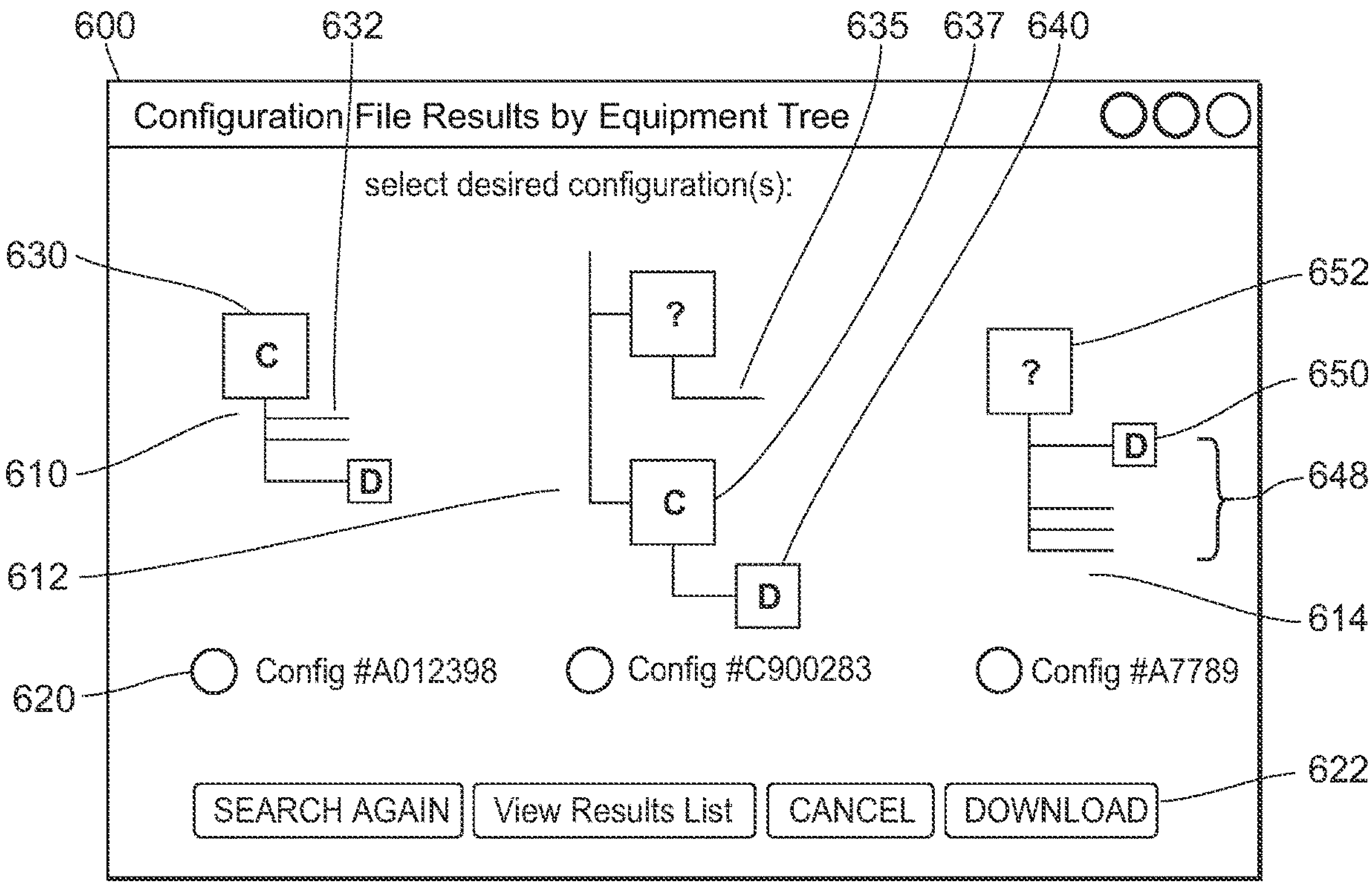
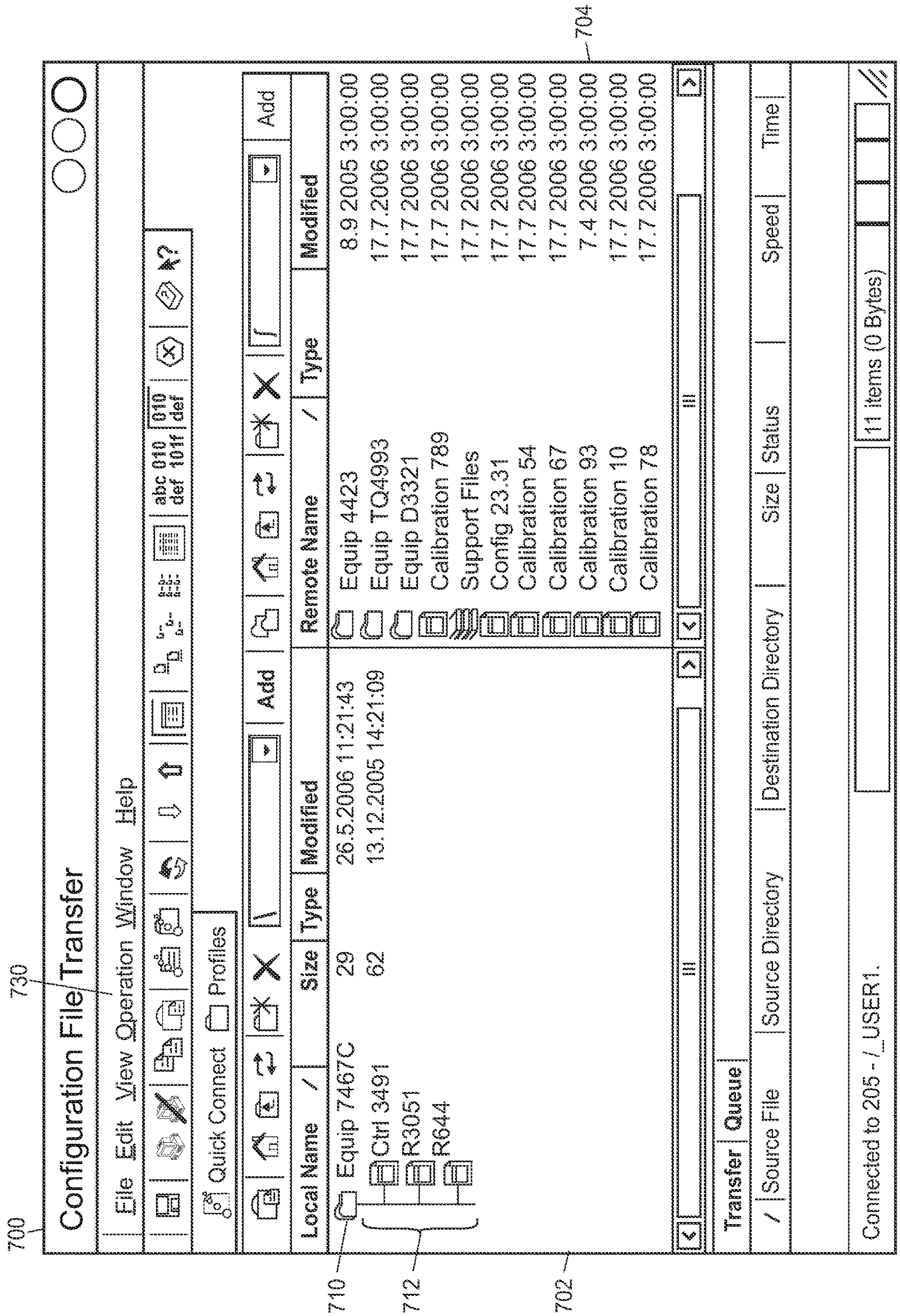
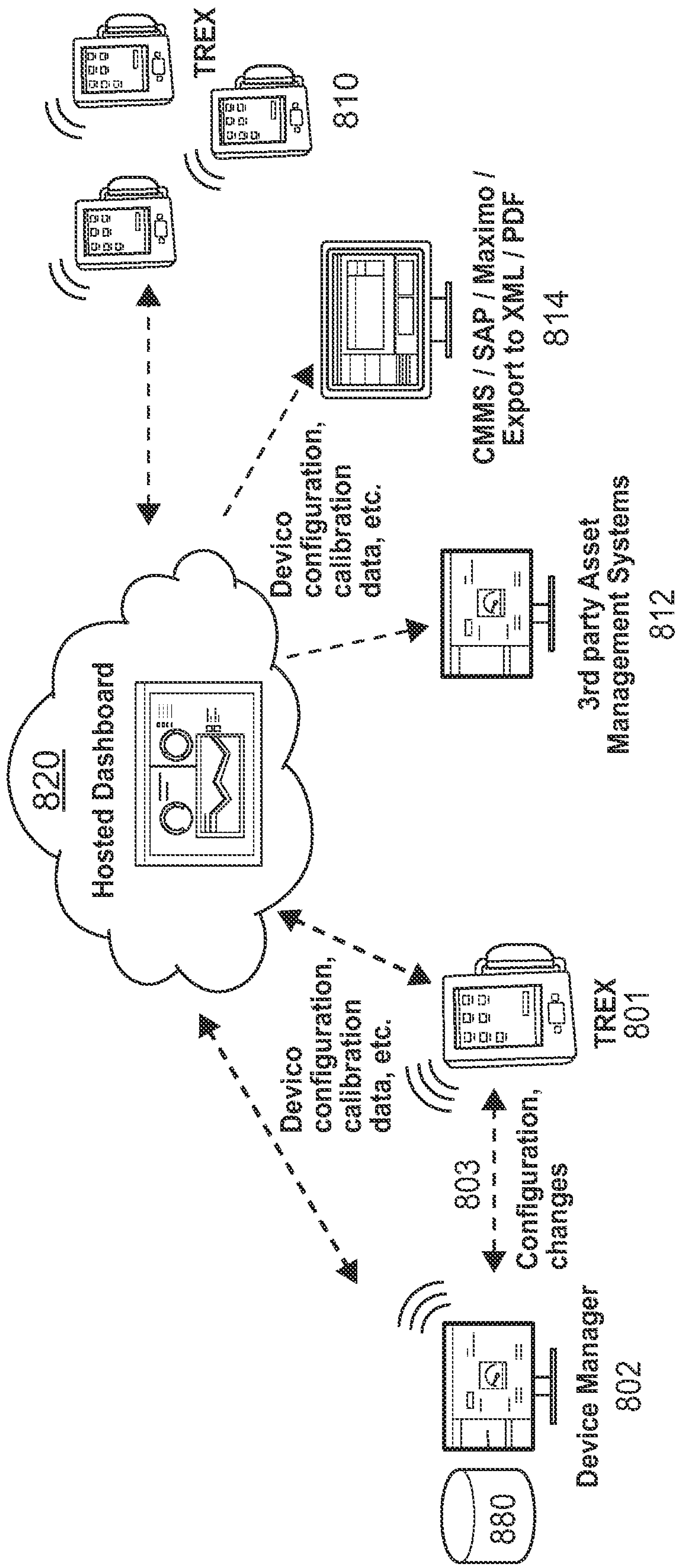

600
632
635
637
640
Configuration File Results by Equipment Tree
select desired configuration(s):
630
C
610
D
612
?
C
D
652
?
650
D
648
614
620
Config #A012398
Config #C900283
Config #A7789
622
SEARCH AGAIN
View Results List
CANCEL
DOWNLOAD

Fig. 6



700
730
704
710
712
702
Configuration File Transfer
File Edit View Operation Window Help
Quick Connect
Profiles
Add
Local Name
Size
Type
Modified
Equip 7467C
Ctrl 3491
R3051
R644
29
62
26.5.2006 11:21:43
13.12.2005 14:21:09
Remote Name
Equip 4423
Equip TQ4993
Equip D3321
Calibration 789
Support Files
Config 23.31
Calibration 54
Calibration 67
Calibration 93
Calibration 10
Calibration 78
8.9 2005 3:00:00
17.7 2006 3:00:00
7.4 2006 3:00:00
Transfer
Queue
Source File
Source Directory
Destination Directory
Size
Status
Speed
Time
Connected to 205 - /_USER1.
11 items (0 Bytes)

Fig. 7



TREX
810
CMMS / SAP / Maximo / Export to XML / PDF
814
Device configuration, calibration data, etc.
820
Hosted Dashboard
3rd party Asset Management Systems
812
TREX
801
Device configuration, calibration data, etc.
803
Configuration changes
Device Manager
802
880

Fig. 8

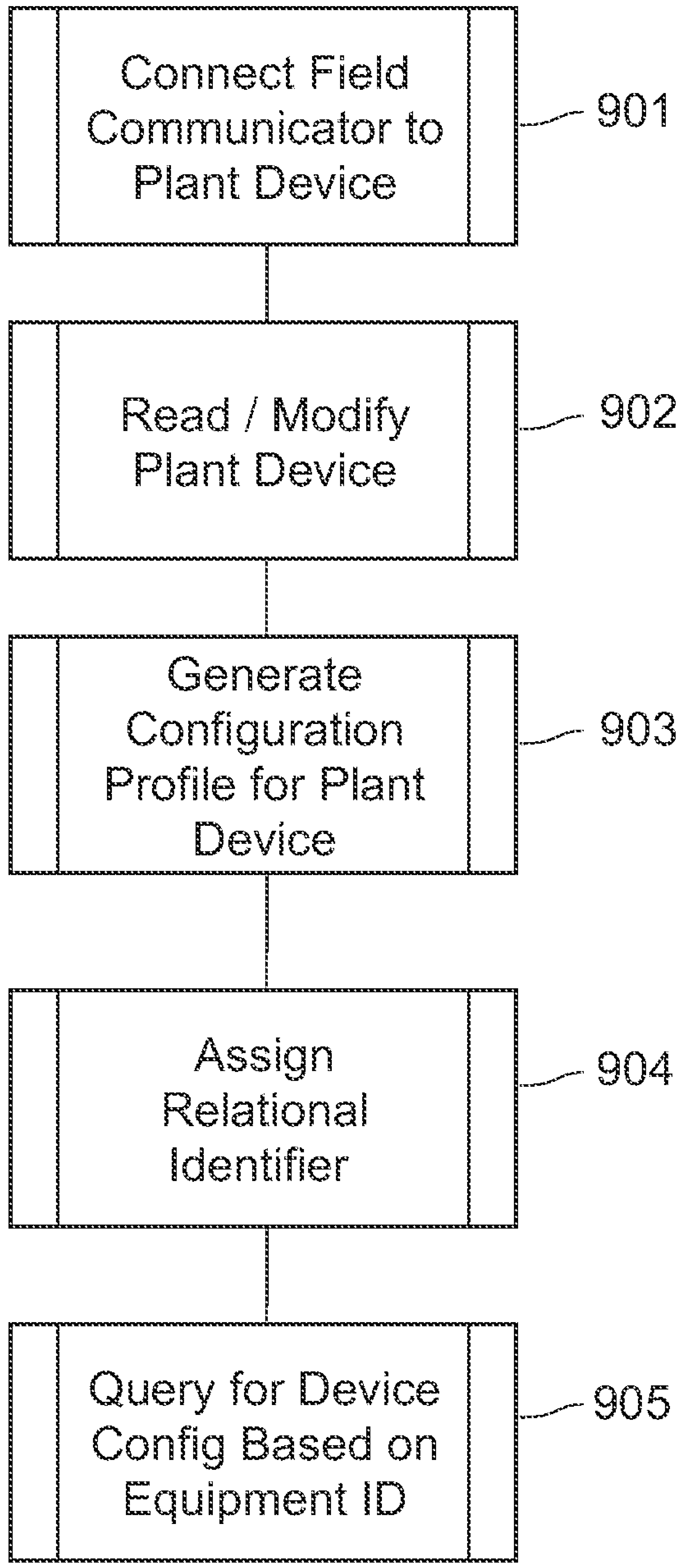

Connect Field Communicator to Plant Device
901
Read / Modify Plant Device
902
Generate Configuration Profile for Plant Device
903
Assign Relational Identifier
904
Query for Device Config Based on Equipment ID
905

Fig. 9

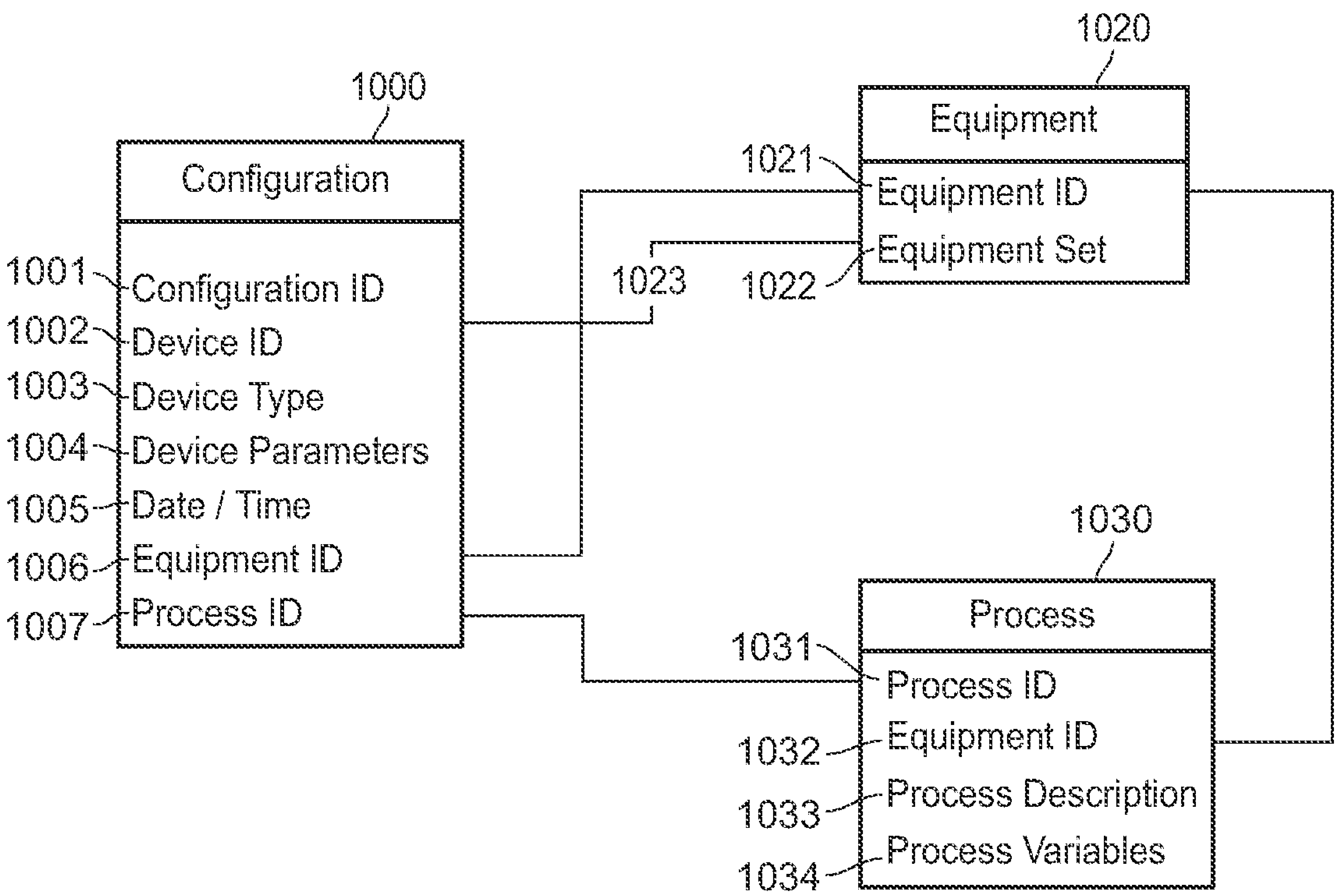

1000
Configuration
1001 Configuration ID
1002 Device ID
1003 Device Type
1004 Device Parameters
1005 Date / Time
1006 Equipment ID
1007 Process ID
1020
Equipment
1021 Equipment ID
1022 Equipment Set
1023
1030
Process
1031 Process ID
1032 Equipment ID
1033 Process Description
1034 Process Variables

Fig. 10

CLOUD-HOSTED INTERFACE FOR PORTABLE DEVICE COMMUNICATORS

FIELD OF TECHNOLOGY

The present disclosure relates generally to process control systems, and, more particularly, to a process control system using handheld communicators to access or configure process control devices in a plant.

BACKGROUND

Handheld communicators are mobile computing devices that are used in or near plant and plant equipment sometimes in hazardous environments where the communicators may be used to configure process control devices, such as controllers and field devices, and to collect data from the process control devices. While communication technology may make possible some remote management and collection of remote device data, handheld communicators may still need to be used to directly connect to a process control device to adjust parameters and collect data. This may be for a number of reasons. Sometimes process control devices, such as field devices, are stranded devices that are remote and non-networked (e.g., for legacy systems with network incompatibilities or for isolated processes by design). In some situations, a device may be networked but communication to the networked device is too slow for certain diagnostic applications or modifications. In some systems, the process control devices may not yet be commissioned (e.g., active or online) or may not yet be completely installed (e.g., awaiting configuration and programming from a handheld communicator). In some circumstances, the process control devices may be malfunctioning and require direct onsite connection for diagnosis, calibration, or adjustment. In some circumstances, location specific factors may need to be considered when making modifications, thereby requiring onsite adjustments to a process control device, even for networked devices. Generally, handheld communicators may be used by technicians to make remote, onsite manual configuration adjustments to process control devices, such as field devices or controllers.

When handheld communicators are being used to read from or make adjustments to a process control device, process control device information that is gathered by the handheld communicator may be stored in an onboard memory. This information may include configuration changes, parameter modifications, calibration data, and other information. The handheld communicators may be designed to periodically or continually upload this configuration data to a central device configuration database when communicatively coupled to the database. If the handheld communicators do not have connectivity to the device configuration database or is not otherwise communicatively coupled to a plant network via, for example, a hard wired connection to a workstation, the communicator may cache recorded configuration changes with date and time stamps for later transfer to the device configuration database once the device is connected.

Generally, these handheld communicators are adapted for one way communication of device information collected in the field (e.g., remote area of a plant or plant network) to a central workstation or server. A secondary system to a distributed process control system (DCS) application, such as an Asset Management System (AMS) may include a device configuration management function that is used to manage a configuration database for storing handheld communicator gathered configuration and calibration information on process control devices within a plant for analysis and maintenance of plant device health. While this information is helpful for centralized operators to perform analysis on device health and schedule maintenance and update work schedules, this information could also be useful to instrumentation technicians in the field when operating to configure devices or adjust parameters of a device.

Currently, instrument technicians may not be able to use their handheld communicators to take advantage of the large collection of information in a centralized configuration database. For example, in particular situations when new processes are being implemented and corresponding equipment is delivered that requires commissioning in a manner similar if not same as an existing set of equipment, configuration information on file may be helpful to the instrument technician. Alternatively, in some plants, replicating or referencing prior configurations may be helpful in plants that have a rotating set of equipment for a particular process or subprocess. In this situation, equipment may be periodically swapped out for another set of equipment for maintenance purposes where replacement equipment may need to be calibrated or configured. Another situation where prior configuration data may be helpful is when equipment is periodically reconditioned or re-purposed for other processes based on schedule or period. While instrument technicians could benefit from referencing at least a stored baseline set of existing configurations for particular types of equipment, locating and downloading appropriate configurations may be challenging since raw configuration data may not be in a form useful to a technician in the field.

SUMMARY

The present disclosure describes a method of and system for sharing process control device configuration data between multiple handheld communicator devices over a plant network or public data store. A handheld communicator may connect to and access a process control device. The handheld communicator may generate a configuration profile that records the device parameters of the process control device sometimes including modifications made by the handheld communicator during a configuration session. In an embodiment, the handheld communicator may assign relational identifiers to the configuration profiles such as equipment identifiers and process identifiers. The configuration profiles may be searched for by device identifiers and equipment identifiers. In an embodiment, the configuration profiles may be differentiated by equipment identifiers and associated equipment profiles along with process identifiers. Upon identifying relevant configuration profiles for an equipment set, the configuration profiles for the equipment set or a portion of the equipment set may be downloaded from the plant network or public data store to one or more handheld communicators for installation.

BRIEF DESCRIPTION OF DRAWINGS

FIG. **1** is a diagram of a distributed process control network located within a process plant or other industrial setting including handheld communicators.

FIG. **2** illustrates a system using a device configuration manager application interface that organizes information from a plurality of device communicators.

FIG. **3** (comprising FIGS. **3**A and **3**B) illustrates an exemplary plant parameters listing showing a configuration of a plant device.

FIG. 4 illustrates an exemplary search interface for querying and retrieving device configuration files according to an embodiment.

FIG. 5 illustrates a search result screen for matching configuration files according to an embodiment.

FIG. 6 illustrates a search result screen for matching configuration files in graphical form according to an embodiment.

FIG. 7 illustrates an exemplary configuration file transfer interface according to an embodiment.

FIG. 8 illustrates a system of managing configuration data and providing configuration data to an instrument technician in the field using a handheld communicator.

FIG. 9 illustrates a method of modifying a handheld communicator to provide organized configuration data based on equipment configuration templates.

FIG. 10 illustrates an example data model that may be used with the method illustrated in FIG. 9.

DETAILED DESCRIPTION

FIG. **1** is a block and schematic diagram of an exemplary process control network **100** operating in a process control system, process plant or other industrial setting **10**. The process control network **100** may include a network backbone **105** providing connectivity directly or indirectly between a variety of other devices. The network backbone **105** may include both wireless and/or wired communication channels or links. The devices coupled to the network backbone **105** may include, in various embodiments, combinations of access points **72**, portable industrial computing devices **112** which may be handheld or other portable computing devices, such as a laptop computer, a tablet, a hand-held smart device, a portable testing device (PTD), etc., stationary industrial computing devices **113**, such as a personal computer, workstation, etc. each having a display screen **114** as well as various other input/output devices (not shown), servers **150**, etc.

As illustrated in FIG. **1**, the controller **11** is connected to the field devices **15-22** via input/output (I/O) cards **26** and **28** which may implement any desired process control communication protocol, such as one or more of the HART, Fieldbus, CAN, Profibus, etc., protocols. The controller **11** is, in FIG. **1**, communicatively connected to the field devices **15-22** to perform control of the field devices **15-22** and therefore control of the plant. Generally, the field devices **15-22** may be any types of devices, such as sensors, valves, transmitters, positioners, etc., while the I/O cards **26** and **28** may be any types of I/O devices conforming to any desired communication or controller protocol. For example, the field devices **15-22** and/or I/O cards **26** and **28** may be configured according to the HART protocol or to the Fieldbus protocol. The controller **11** includes a processor **30** that implements or oversees one or more process control routines **38** (or any module, block, or sub-routine thereof) stored in a memory **32**. Generally speaking, the controller **11** communicates with the devices **15-22** and the host computers **113** to control a process in any desired manner. Moreover, the controller **11** implements a control strategy or scheme using what are commonly referred to as function blocks (not shown), wherein each function block is an object or other part (e.g., a subroutine) of an overall control routine that operates in conjunction with other function blocks (via communications called links) to implement process control loops within the process control system **10**. Function blocks typically perform one of an input function, such as that associated with a transmitter, a sensor or other process parameter measurement device, a control function, such as that associated with a control routine that performs PID, fuzzy logic, etc. control, or an output function that controls the operation of some device, such as a valve, to perform some physical function within the process control system **10**. Of course, hybrid and other types of function blocks exist and may be utilized. The function blocks may be stored in and executed by the controller **11** or other devices.

As illustrated in FIG. **1**, wireless gateways **35**, and wireless communication networks **70** are likewise communicatively coupled to the network backbone **105**. The communication networks **70** may include wireless devices **40-58**, which include wireless field devices **40-46**, wireless adapters **52***a* and **52***b*, access points **55***a* and **55***b*, and a router **58**. The wireless adapters **52***a* and **52***b* may be connected to non-wireless field devices **48** and **50**, respectively. Though FIG. **1** depicts only a single one of some of the devices connected to the network backbone **105**, it will be understood that each of the devices could have multiple instances on the network backbone **105** and, in fact, that the process plant **10** may include multiple network backbones **105**.

The industrial computing devices **112**, **113** may be communicatively connected to the controller **11** and the wireless gateway **35** via the network backbone **105**. The controller **11** may be communicatively connected to wireless field devices **40-46** via the network backbone **105** and a wireless gateway **35**. The controller **11** may operate to implement a batch process or a continuous process using at least some of the field devices **15-22** and **40-50**. The controller **11**, which may be, by way of example, a DeltaV™ controller sold by Emerson Process Management, may be communicatively connected to the process control network backbone **105**. The controller **11** may be also communicatively connected to the field devices **15-22** and **40-50** using any desired hardware and software associated with, for example, standard 4-20 mA devices, I/O cards **26**, **28**, and/or any smart communication protocol such as the FOUNDATION® Fieldbus protocol, the HART® protocol, the Wireless HART® protocol, etc. In the embodiment illustrated in FIG. **1**, the controller **11**, the field devices **15-22** and the I/O cards **26**, **28** are wired devices, and the field devices **40-46** are wireless field devices.

Moreover, the one or more portable industrial devices **112**, which may be field device maintenance tools, multimeters, portable loop power supplies, field device configuration tools, etc., may be intermittently communicatively connected to one or more of the field devices **15-22**, **40-50** and/or to one or more of the buses or communication lines to which the field devices **15-22**, **40-50** are connected (e.g., a HART loop, a Fieldbus segment, etc.), with such connections being illustrated with dotted lines in FIG. **1**. Such network connections may include the hardwired lines connecting one or more of the field devices **15-22**, **40-50** to the I/O cards **26** and **28** via the backbone **105**, for example. Alternatively, the portable industrial devices **112** may be communicatively connected directly to ones of the field devices **15-22**, **40-50** (e.g., via communication terminals present on the field devices **15-22**, **40-50**). In some cases, the portable industrial devices **112** may provide power to the field device **15-22**, **40-50** or to the wire loop to which it is connected. Moreover, the portable industrial devices **112** may enable a user to communicate with, configure, perform maintenance activities on, and/or diagnose one or more of the field devices **15-22**, **40-50** when these field devices are installed in the plant. In still other cases, the portable industrial devices **112** may include wireless interfaces that may be used to connect wirelessly to one or more of the field devices **15-22**, **40-50**, such as a Bluetooth interface, a Wi-Fi interface, or a wireless process control protocol interface or connection, such as those that use the WirelessHART protocol. The portable industrial devices **112** may be described herein or referred to herein as handheld communicators and may directly connect to industrial computing device **113** (described herein also as a workstation) via a hard wire cable such as a USB connection to upload collected device data to the computing device **113** or the server **150** and database **151** via the computing device **113**.

The handheld communicators **112** may generally be used for configuring, supporting, and maintaining field devices and may thus be used to, for example, support process measurement devices, such as pressure, temperature, level, flow analytical sensor, flow meters, valve positioners, etc. However, the handheld communicators **112** could be used to support, connect to, maintain, communicate with, or otherwise be used with other types of devices including, for example, vibration detection and analysis equipment, power generating equipment, switches, motors, pumps, compressors, drives, mechanical vessels, such as tanks, pipes, etc., electrical power distribution devices, switch gear, motor control centers any other stand-alone equipment (e.g., equipment not communicatively connected to a process controller, for example), or any other types of industrial equipment. In these cases, the handheld communicators **112** could have various different types of communication and electrical generation and detection hardware (e.g., voltage, current, impedance, etc. generation and detection equipment) to perform maintenance on, configuration of, and/or communication with these other types of industrial equipment.

In some embodiments, the handheld communicators **112** may be brought to the site of one of the field devices **15-22**, **40-50** in the process plant. The handheld communicators **112** may be temporarily connected via a wired and/or a wireless connection to the field device **15-22**, **40-50** for calibrating, configuring, troubleshooting, monitoring, controlling, or performing any other suitable operations on the field device **15-22**, **40-50**. Additionally, the handheld communicator **112** may be temporarily connected via a wired and/or wireless connection to the controller **11** for calibrating, configuring, troubleshooting, monitoring, controlling, or performing any other suitable operations on the controller **11**.

In operation, the industrial computing devices **112**, **113**, may each execute a user interface (UI), allowing the industrial computing device **112**, **113** to accept input via an input interface and provide output at a display. The industrial computing device **112**, **113** may receive data (e.g., process related data such as process parameters, permissions, log data, sensor data, and/or any other data that may be captured and stored) from the server **150**. In other embodiments, the UI may be executed, in whole or in part, at the server **150**, where the server **150** may transmit display data to the industrial computing device **112**, **113**. The industrial computing device **112**, **113** may receive user interface data (which may include display data and permission data) via the backbone **105** from other nodes or endpoints in the process control network **100**, such as the controller **11**, the wireless gateway **35**, other industrial computing devices, or the server **150**. The server **150** may be communicatively coupled to a database or data store **151** which can hold data for one or more process control applications running at least at the server **150** or at a device **113**. As used herein plant devices such as controllers, field devices, and I/O devices used to manage and control one or more process variables are herein referred to as process control devices or plant devices.

FIG. **2** illustrates a graphical user interface for a plant device configuration application **200** to manage process control device configurations in the process plant. In some systems, a device configuration application may be communicatively coupled to a device configuration database for storing and recording configuration and calibration information on plant devices. In some systems, the handheld communicators **112** described above may be an integral part of the data collection scheme of the device configuration application. A typical user of a handheld communicator **112** may be an instrumentation technician. The collected configuration data from the handheld communicators **112** may be organized in a manner as illustrated in FIG. **2**.

FIG. **2** illustrates a plant workstation **208**, such as device **113**, connected to a plant configuration database **210**. The plant database **210** shows an organization of configuration files based on categories including plant location **212**, area within a plant **214**, plant unit **216**, and devices/equipment **218**. The categories may be selected or opened to view details or content of the category. For example, a device icon under the equipment/devices category **218** may represent a configuration file for the device **220**, **221**, **222**, **223**. Device **220** may be a controller or a control module of the controller. Device **221** may be pressure transmitter. Device **222** may be a valve actuator. Device **223** may be a valve position transmitter. Selecting a device icon **220-223** may display the contents of a configuration file for a device. FIG. **3** illustrates an example configuration file **300** for a process control device such as a pressure transmitter. It should be noted that the organization illustrated in FIG. **2** is exemplary only and in some embodiments, only some categories may be used to organize configuration data.

Existing handheld communicators may be primarily designed to safely connect to a process control device, configure that device and route configuration data in one direction: towards a central device configuration database **210** (e.g., via a device configuration manager application **200**). Handheld communicators may be designed to be intrinsically safe where restrictions are placed to minimize power consumption in such devices. The effect of these restrictions may be to limit processing capacity and memory storage of the handheld communicators which in turn may limit a number, size, and type of applications that can be running on a handheld communicator. Processing capacity of a handheld communicator may prioritize applications that serve the primary function of the communicators: on-site manual configuration of plant devices, caching or recordation of device configurations, and transfer of those device configurations to a central repository to free up local device memory for additional configurations. Generally, the configuration data may be used for centralized record keeping and report generation. For example, a device configuration manager **200** as discussed herein may be part of a larger suite of applications that uses device configuration data, among other types of data and sources, to generate useful aggregated device maintenance reports, device health reports, etc.

While retrieving and referencing a prior device configuration file may be useful in replicating parameter changes for a different but similar device, configuration data may be retained in a manner where locating appropriate configuration files for use at a handheld communicator may be cumbersome and time consuming. FIG. **3** (made up of FIGS. **3**A and **3**B) illustrates a general configuration file that be stored in memory or a configuration database. FIG. **3** illustrates data generally collected from a configuration of a process control device such as a Rosemount **3051** pressure sensor/transmitter. The configuration may be specific to the process control device and identified by device ID **310**, device model/type **312**, and function **314**. FIG. **3** illustrates that the configuration file or profile may contain a full listing of all parameters of a pressure transmitter. Querying a data store, database, or table by device type **312** or even device tag **310** may produce many dozens or hundreds of files. Finding or distinguishing one or a few of the configuration files that are appropriate for a particular process control device application may be more cumbersome than performing a manual configuration or testing process anew. Loading a large number of these configuration files, as a result of these types of searches may be unfeasible with the limited processing capacity of the handheld communicators.

As discussed above, the limited capacity and transient nature of configuration files in handheld communicators may severely limit the type and number of configuration profiles retained in a particular handheld communicator. However, where a technician may recognize the appropriateness of replicating a configuration on one or more devices, and that configuration data is available on the technician's handheld communicator, the technician's workload and efficiency may be greatly reduced in replicating and installing the referenced configuration data to those machines. However, having the appropriate configuration file remaining in a handheld communicator may be a product of happenstance.

There are times when a technician may desire to replicate the configuration process for a current device from a configuration the technician has performed in the past on a similar device with a similar set of circumstances. Alternatively, there may be times when a technician may desire to replicate a configuration based on a configuration performed by different technician where a particular difficult or complex configuration is to be made on a similar setup. When a technician would like to replicate a configuration, the technician may favor using configurations the technician installed in prior sessions because the technician has prior knowledge of the installation and the circumstance(s) for that configuration. For example, a technician may have recent knowledge of the circumstances for servicing or configuring a control valve. However, once device configuration data is uploaded to an AMS device manager, that data may be deleted from the handheld communicator due to memory constraints. Moreover, the handheld communicators may be assigned to different technicians with no guarantee that a technician will be able to use the same handheld communicator in a prior session.

A field technician generally tasked to perform remote site configurations using handheld communicators may greatly benefit from referencing configuration data the user has prior experience with or that matches a set of circumstances surrounding a current device the technician is servicing. For example, similar circumstances may include a similar or identical set of equipment communicatively coupled to a process control device that the technician recognizes. Useful configuration data may include the configuration files that the technician was personally involved in creating since the user has firsthand knowledge of the circumstances surround the configuration, e.g., field factors, devices connections, etc. Moreover, a field technician may also greatly benefit from configuration files generated by other field technicians where the configuration files may be similar or match a set of current equipment and/or process.

FIGS. **4-6** illustrates a set of user interfaces for managing process control device configuration files that are generated by one or more handheld communicators and centrally stored for retrieval upon demand by handheld communicators. FIG. **4** illustrates an exemplary search screen **400** for querying or searching for configuration profiles. An input box **401** allows a user to enter a process control device identifier (ID) or a device type. In an embodiment, the device identifier may indicate a device type. Input box **403** allows a user to input a set of relational equipment identifiers or an equipment profile associated with the device in input box **401**. Input box **405** allows a user to input a process control identifier, a process description or type, or a set of process variables for identifying a process affected by the device identifier or device type in box **401**.

FIG. **5** illustrates a configuration search result window **500** including an exemplary listing of configuration files or profiles **502** by configuration identifier that matches or partially matches the query of FIG. **4**. FIG. **5** illustrates a column for configuration identifiers **510**, equipment set **512**, and equipment identifier (ID) **514**. In an embodiment, the search results may also indicate a process identifier (not shown). The user may select one or more configuration profiles to download to, for example, a handheld communicator, by clicking the selection circles **520** next to each configuration profile set and then selecting download **522**. FIG. **5** also illustrates that a user may select to view an equipment graph **524** for the configurations showing the connections or associations between the equipment set.

FIG. **6** illustrates a search result set **600** window displayed as equipment graphs. The result set of FIG. **5** are shown as equipment graphs **610**, **612**, and **614**. Similar to the table listing illustrated in FIG. **5**, a user may select one or more sets of configuration profiles (based on equipment set) to download by clicking the selection circles **620** and then selecting download **622**. FIG. **6** illustrates that the graphs show nodes **630** and terminal lines **632**, where the nodes **630** may indicate a controller or an I/O device where the terminal lines **632** may indicate field devices. FIG. **6** is only an exemplary embodiment of a display graph that can be used. In other embodiments more or less details may be added to the display results and may use different icons and graphing conventions. Graphs **612** and **614** illustrate one particular feature of an embodiment for the equipment profile results. In particular, an equipment set here may include a plant device **635** such as a field device that is not under the direct control of a controller **637** for a current target device **640** marked with letter “D”. The field device **635** may be included in the equipment set as it is referenced by a technician that generated the equipment. This may be the case where the device **635** may be a field device involved in the same process or related process as the target device **640**. Another feature is that not all device connections may be a part of the equipment profile. For example, in equipment profile graph **614**, the field devices **648** including a target device **650** may be part of an equipment profile even though a controller **652** (e.g., displayed with a question mark “?”) is not included.

FIG. **7** illustrates an exemplary file transfer or download selection screen **700**. The example file transfer screen of FIG. **7** may be reached when a user selects, for example, the first configuration file of FIG. **5** or **6** and then selects download **522** or **622**. FIG. **7** illustrates a left transfer box **702** for a source of the configuration files, such as an AMS device manager application or configuration database, and a right transfer box **704** as a destination for transfer of the configuration files. FIG. **7** shows that the left transfer box **702** is populated by the equipment set **710** marked as “7467C’ selected in FIG. **6** or **7** including component configuration files **712** of each device under the equipment set. In an embodiment, a user may select all or a subset of the configuration files **712** to download to a handheld communicator memory illustrated in the right transfer box. In an embodiment, the user may click on one or more of the icons associated with the device configuration files **712** to mark those configuration files for transfer. In an embodiment, the user may select the menu "Operation" **730** and select an option under that menu to transfer the files to the destination device. After successfully transferring the files, the right transfer box **704** may be populated with the corresponding transferred files. In alternative embodiments, an action button for the transfer may be included on the GUI to initiate the transfer.

FIG. **8** illustrates a handheld communicator **801** communicatively coupled to a workstation or server hosting a device manager application **802**. As discussed the communication coupling between a handheld communicator **801** and a device manager **802** has traditionally been one way: towards the device manager for uploading device configuration and calibration data. FIG. **8** illustrates that the data flow may be two ways **803** using the method and system described herein. In this system, the handheld communicator **801** may be adapted to download data from the device configuration manager **802** using the search and retrieval process described. FIG. **8** also illustrates that handheld communicators **810** as well as the device configuration manager **802** for a particular plant may be communicatively coupled to a cloud server **820** or public data store. The cloud server may allow third party applications such as asset management applications **812** or CMMS applications **814** to access the configuration files.

The handheld communicators **801** and **810** of FIG. **8** may be adapted to assign relational information to the configuration files that describe secondary devices to or processes affected by a process control device or process control device configuration. The relational information may vary based on user input, but at least some relational data (e.g., a small set of associated equipment) may be used to determine whether a configuration file is appropriate for replicating to another similar type of device(s) and/or is recognized by a technician or handheld communicator device that generated the configuration file.

The device configuration manager **802** may receive the configuration files with relational information and store the configuration files indexed by equipment identifier and/or process identifier.

Using the search interfaces of FIGS. **4-7** and the system of FIG. **8**, a user may now be able to query for configuration files for a plant device based on equipment sets or equipment profiles and retrieve those configuration files over a plant network or via cloud access when connected. A technician may search for configuration files based on device connections that may be relevant to a particular process control device's configuration. The technician may be able to search for a configuration of a device not only by its identifier or type but also by what the device is connected to. As plant devices are frequently connected to other devices, the identity and types of connected devices may usually play a role in the configuration of the device. The connections of the other equipment to the device may be helpful in identifying a particular configuration file or profile (used interchangeably herein) generated by a handheld communicator or a by a user of the handheld communicator. In circumstances where a plant device is a standalone device, an equipment set of one element may also provide valuable information on the configuration of the device. In particular, standalone devices may have particular applications and these types of devices may further be distinguished based on the process the device is used to manage. A process identifier in this situation may be helpful in searching for the configuration for the device.

In an embodiment, the equipment identifier may indicate a set of process control devices associated with a device. For example, if a device is a field device sensor, an associated device could be an I/O interface, a process controller, or other field device sensor monitoring the same or similar process. In an embodiment, the equipment identifier may identify a group of equipment that includes a current device and the configuration of that device within the group. When querying for the configuration files based on equipment identifier, the identifier may return different portions of an equipment set surrounding a particular device (see for example graph **652**) including, in some embodiments, the configuration profiles for each equipment in the group. The results of the query can be further reduced by the type of equipment identifier or equipment set indexed to the equipment identifier. For example, in some equipment sets, the equipment identifier may only include the current field device and the controller communicatively coupled thereto. In an embodiment, it may include additional sensors or I/O devices. In an embodiment, the equipment identifier may be user specified or generated based on a configuration session with a technician where the equipment identifier is assigned based on a limited set of observations by the user or the handheld communicator.

The device configuration manager **802** may record indexed configuration profiles by equipment identifiers. In an embodiment, the device configuration manager may also index configuration profiles by process or by a process identifier. Generally, a plant process or subprocess may be defined by a set of process variables. For example, in a filling process, the process variables may describe a plant process action as a filling process defined by a flow rate, temperature, pressure, etc. Process control devices may generally be used to manage these plant processes, where configuration of the process control devices is generally related to one or more of such plant processes. Process variables may be observable relational data that may also be used to assist a technician in finding an appropriate configuration file. In an embodiment, the process control identifier may index a process control module that controls a particular set of equipment to manage a process variable.

In some embodiments, additional identifiers for describing the configuration profile may be assigned. In an embodiment, a location identifier may be assigned indicating a position of a process control device. The location may be local, for example within a process plant, or more global such as a city or town (e.g., by using GPS coordinates). In an embodiment, a location identifier may be metadata specific to a particular process plant. If the location data has relevance to a configuration it may be used as an additional relational identifier assigned to the configuration profiles similar to an equipment identifier or a process identifier.

A device configuration database (CDB) **880** may be communicatively coupled to a workstation running a device configuration manager **802** and may provide configuration files related to DCS and AMS applications using the data based on device identifier and device type. In an embodiment, the CDB **880** may also store configuration files with equipment identifiers and the associated partial equipment profiles. While the device configuration manager **802** may have access to a broader set of data the includes more complete equipment maps of some or all device connections within a plant, the partial equipment profiles associated and/or received with a device configuration as described may still be stored as partial equipment profiles in database **880**. The relational information in the equipment identifiers and process identifiers may provide relevant device configuration information that otherwise may not be captured by existing device configuration processes. In particular, the equipment identifiers may capture handheld communicator specific and technician specific associations for the configuration files. For example, in a case of diagnosis and repair of a field device, the equipment profile generated for that configuration may provide a technician more identifiable and distinguishable information on the repair configuration when related to an associated device. The partial equipment profiles may relate to a particular configuration process that provides additional meaning and information not provided by simply referring to a system map of device connections. For example, a first user may generate an equipment profile when configuring a field device sensor **1** by observing and recording a field device sensor **2** associated with sensor **1** in the field for a particular process. The association of sensor **2** to sensor **1** is valuable identifying information for the configuration profile and is recorded by the CDB in an embodiment. It should be noted that the configuration of the first sensor may be affected by the existence of the second sensor. Thus, user input associating the first and second process control devices (sensor **1** and sensor **2**) may have relevance to the configuration profile.

FIG. **8** illustrates a cloud storage application or server **820**. This cloud server **820** could provide a distributed data store of device configurations that may now be searched by device type(s), equipment profile/equipment identifier, and/or process profile/process identifier. This cloud sharing may be a privately supported database, for example an equipment manufacturer database, that provides open source configurations files identified by equipment identifier and process identifier. Because the configurations may be identified by associated equipment or associated subprocess, the data may be anonymized to a certain degree. In some embodiments, plant specific identification attributes may be stripped or removed from the configuration data before it is pushed to a public data store such as a cloud server **820**. In this manner, plants and plant management may be more open to sharing their configuration files or having them uploaded to a shared platform external to their own plants.

In an embodiment, upon downloading a desired set of configuration profiles by a handheld communicator using the system and method described herein, the handheld communicator may be adapted to automatically install those configurations without a user needing to proceed through a device menu screen to make parameter changes to a process control device. By downloading an equipment set of configuration profiles, the user or technician may be able to replicate the configuration an entire group of related or associated equipment thereby saving time and effort.

FIG. **9** illustrates an exemplary method for managing configuration data of a handheld communicator to enable quick retrieval of relevant plant device configuration data sets for replication. At block **901**, a first communicator device may be connected to a first process control device for accessing or servicing the first process control device. The first communicator device may be connected directly to the process control device such as a field device using, for example, a cable. In other embodiments, the first communicator may be connected using a non-wired connection or wireless connection. As discussed, restrictions may be in place for handheld communicators where only certain kinds of wireless connections may be permissible for connection to a process control device. Once the first handheld communicator is communicatively coupled to the first process control device, the handheld communicator may access a device parameter menu of the first process control device.

At block **902**, the first handheld communicator may read parameter values and modify parameter values of the first process control device once connected to the process control device. The configuration reading and adjustments may be performed by a technician using a device parameter menu displayed and accessed by the first handheld communicator. A current state of the field device may be read by the handheld communicator and displayed to a technician using a user interface of the first handheld communicator. The technician may then configure or adjust parameters of the first process control device. In an embodiment, a configuration file may be installed using an installation program of the communicator without using a device menu tree of the process control device for each device parameter change.

At block **903**, a configuration profile may be generated for the first process control device. In an embodiment, the configuration profile may include a device identifier, a device type, a set of process control device parameters, and a date/time stamp. The set of process control device parameters may include the device parameters modified by the first handheld communicator. In an embodiment, the handheld communicator may generate a configuration profile for the first process control device when performing a read of the device without parameter changes.

At block **904**, a relational identifier such as an equipment identifier may be assigned to the configuration profile generated at block **903**. An equipment identifier may index an equipment profile that includes the first process control device. The equipment profile may include a set of process control devices that are associated with each other. The equipment profile may include device identifiers of associated process control devices. In an embodiment, the set of process control devices of an equipment profile may be communicatively coupled to each other. For example, the set of process control devices may represent a segment of a process plant used to perform a process or a subprocess. For example, in a process plant having a filling process or subprocess, a segment may be a control loop for the filling process that includes equipment or set of process control devices including a field device flow sensor, a valve actuator, a process controller, and one or more I/O devices. In an embodiment, the handheld communicator may execute a segment analysis or a detection routine on a process control device to determine other devices that the process control device is communicatively coupled with. The handheld communicator may then generate an equipment profile with corresponding equipment identifier for this set of devices.

In an embodiment, the set of process control devices may include some devices that are not communicatively coupled to the first process control device but have a relationship to the first process control device. For example, some devices may be proximal to the first process control device or may affect a related process as the first process control device but may not be in direct communication with the first process control device. In some circumstances a technician may service unrelated process control devices. For example, some devices a technician services may belong to a different equipment profile.

In an embodiment, assigning an equipment identifier at block **904** may include assigning a different equipment identifier to each configuration for each separate process control device configured by a handheld communicator. In an alternative embodiment, assigning an equipment identifier at block **904** may include determining whether a device identifier of the first process control device is already associated with an equipment profile referenced by the first handheld communicator. For example, in a situation in which a technician has serviced multiple field devices in a remote area of a plant, a subset of the field devices may belong to the same equipment profile. In an embodiment, the handheld communicator may be programmed to prompt a user whether a new process control device currently being accessed or configured belongs to one of an existing set of equipment profiles. For example, the handheld communicator may prompt the user upon saving a configuration profile whether the device or configuration profile is associated with a listing of existing equipment (stored in memory) and allows the user to select an equipment profile from a displayed list to associate with a current configuration.

In an embodiment, the equipment profile may be generated by the handheld communicator. In circumstances where the handheld communicator is initiating a new workflow and has no prior configurations referenced, a new equipment profile may be generated with an equipment set of one device (e.g., an equipment set containing the currently configured first processed control device). The equipment identifier may be generated as a unique identifier. As additional devices are configured by the handheld communicator, the equipment profile may be modified to include the additional devices. In an embodiment, the handheld communicator may periodically prompt a user to confirm whether a current configuration profile is associated with one or more equipment profiles referenced by the handheld communicator. In an embodiment, the handheld communicator may reference a set of equipment profiles stored in an internal memory where the reference equipment profiles may have been downloaded during a connection period with a device configuration manager or device configuration database. In this embodiment, the referenced equipment profiles may include location information and be indexed by location identifiers which can be assigned to a configuration profile. In an embodiment, the reference equipment profiles may provide reference information for a user to confirm a certain set of connections or identify proximal devices without installing the configurations of the equipment profile. In this embodiment, the user and the handheld communicator may still create a separate equipment profile from the referenced and downloaded profiles for a current device configuration.

In an embodiment, the handheld communicator may receive an input from a user to assign an equipment identifier, or an equipment profile, to a field device or other process control device. For example, the user may input device identifiers for equipment proximal to the first process control device being serviced thereby creating an equipment profile. The handheld communicator may be programmed to assign a unique equipment identifier to the user generated equipment profile. In another example, the user may input equipment identifiers for other plant devices affecting the same process as the first process control device. In an embodiment, a process control identifier may be used to further distinguish equipment profiles or match equipment profiles.

FIG. **10** illustrates a data model that may be used to enable process control device configuration data to be easily managed, stored, and retrieved by technicians for replicating installations according to an embodiment. The data model may be implemented as a database or tables in a database, such as DCB **880**. FIG. **10** illustrates that a configuration profile **1000** may include the following parameters: configuration identifier **1001**, device identifier **1002**, device type **1003**, device parameters **1004**, and date/time **1005**. The configuration profile may be assigned an equipment identifier **1006**. The date/time stamp **1005** may be a date and time the configuration profile was generated or updated. In some embodiments, the configuration profile may also include a process identifier **1007** that identifies a process profile.

The equipment profile **1020** may include an equipment identifier **1021** and an equipment set **1022**. The equipment set **1022** may be a listing of device identifiers. As shown by line **1023**, the equipment set **1022** or equipment profile for a configuration of a device may include the device identifier **1002** of the device. In some embodiments, the device identifiers **1022** may also index device profiles that provide additional descriptive information of the device such as device location. Alternatively, device location may be an attribute or parameter of the configuration file for a device.

The process profile **1030** may include a process identifier **1031**, an equipment identifier **1032**, a process description **1033** and process variables or process parameters **1034**. The process description may be an organization designated name for the process or subprocess of the plant such as Hot Fill F001. The process description may also describe the process type, such as "Filling." The process variables may be parameters that define the process such as pressure, level, temperature, flow, etc.

The data model of FIG. **10** may describe relationships between devices, equipment, and processes. Generally a plant process may require a set of devices or equipment to operate a plant process. The same equipment however may be used by other processes. This may be the case in plants that have different batch processes scheduled using the same equipment set. Further, equipment may be regularly rotated for maintenance or other reasons for the same process. FIG. **10** illustrates that equipment, equipment sets, or equipment profiles (described interchangeably herein) may have different configurations or configuration profiles depending on a process. A process may have different equipment with different configurations. Devices may belong to more than one process and more than one equipment set. By assigning the appropriate equipment identifier and process identifier to a configuration profile of a device, a technician may be able to use these identifiers to easily reference, retrieve, and share relevant device configuration profiles easily when configuration data is accessible across communication platforms. Moreover, a technician may be able to access configuration profiles that the technicians themselves created by referencing a group of devices that were associated with a device type or a process affected by the device type (or particular device, for example, with unique device identifier). These references may make device configurations easier to distinguish from each other and incorporate additional relevant connection information to the configuration data, thereby making searching for the appropriate configuration data for device replication easier and more convenient.

Referring back to FIG. **9**, at block **905**, a plant device configuration (e.g., configuration profile) may be queried for or searched for based on equipment related to the plant device. Using the described method and system of storing and marking data, queries may be made based on a technician's observation of the environment surrounding a process control device. For example, a technician may want to replicate a configuration profile for one or more devices. The technician may search for or reference configuration profiles by their relational descriptors, such as by an equipment set or by a process. For example, the user may be in the field and encounter a similar set of devices as a previous installation or device calibration. Instead of performing a configuration process from the beginning, the technician may want to use a previous configuration file or profile. The user may want to retrieve one or more prior configuration files (e.g., configuration profiles) from a central configuration database for automatic installation by the handheld communicator on one or more process control devices. As discussed, querying for a configuration file by device identifier alone may generate a large number of results as a plant may have several of the same type of device. Using the described techniques, the technician may, for example, generate a query using device identifiers of nearby devices to reduce the result set. Where multiple configuration profiles exist for the same equipment, a process identifier may be used to further distinguish the appropriate configuration profiles to retrieve a configuration(s) for a user's particular situation. For example, besides observing associated devices to a target device, the technician may also recognize a particular process being managed by the process control device currently under configuration.

In addition to querying a central device configuration manager or database for configuration profiles, handheld communicators may query for and retrieve configuration data from another handheld communicator at block **905**. For example, in situations where a direct connection or wireless connection exists between two communicators, a technician at a first communicator can easily determine if a second communicator has an appropriate configuration file for applying to a particular process control device in the field. A partial equipment profile with only a small number of associated equipment contained therein or a process identifier may be useful in determining whether configuration profiles stored in the second handheld communicator can be used by the technician on a current process control device in maintenance.

In an embodiment, the equipment identifier may be used to uniquely identify an equipment profile to a handheld communicator or a user. Multiple configuration profiles may have similar or same equipment listed in an equipment profile for the same device. For example, a first technician may make a first adjustment using a first communicator, thereby generating a first equipment identifier and a corresponding equipment profile for a configuration. At a different time, a second technician may make a second adjustment using the first communicator thereby generating a second equipment identifier and equipment profile. The first and second configuration may be for the same process control device but have different equipment profiles and consequently different equipment identifiers. In an embodiment, when a query to a configuration database is made based on device identifier or device type with an equipment profile, it may be possible that multiple configuration profiles are outputted with the different partial equipment profiles. A factor in determining a desired partial equipment profile is user input at the handheld communicator. The described method and system may be used to identify or locate a configuration profile that is associated with particular set of equipment and where the configuration of the device is correlated to technician observed factors in the filed necessary to calibrate the process control device.

With reference to FIG. **8**, the configuration profiles having equipment profiles and process identifiers may be used for cloud sharing applications. Generally a cloud sharing service or application is a service that provides simultaneous access for multiple users to a common set of file data in a public online database. In an embodiment, a central public data store that receives equipment profiles and process profiles cross-plant and cross-companies may be maintained for sharing configuration files to a larger group of plant operators or technicians. This central configuration database may contain a large number of configuration profiles to assist new process installations by locating appropriate configurations across a plurality of plants easily based on partial equipment profiles and process profiles. In an embodiment, equipment profiles and process profiles may be anonymized to maintain confidentiality of participant configuration data contributors.

In an embodiment, the equipment identifiers may be generated to be universally unique based on any number of techniques know in the art and based on, for example, process control device serial numbers, date-time values, random variables, etc. These equipment identifiers may be unique not just within a plant, but across plants and companies. In an embodiment, the configuration profiles may be stored with equipment profiles having the uniquely generated equipment identifiers. In this embodiment, a query for configuration data (e.g., configuration profiles) based on device and equipment profile may result in multiple configuration profiles having matching equipment profiles. In an embodiment, a handheld communicator may be programmed to determine whether an equipment profile was generated by the handheld communicator itself. The handheld communicator may determine this by keeping a record of equipment identifiers the handheld communicator has generated. Storing identifiers may take relatively small space compared to a complete configuration file or equipment profile. Alternatively, the handheld communicator may generate the uniquely based identifier based on proprietary encoding methods that a plant implements and the handheld communicator may be programmed to recognize those it encoded itself. In this embodiment, the handheld communicator may recognize its own device configurations and mark those configurations in a display. For example, when displaying a listing of configuration profiles resulting from a search of a larger public cloud sharing service, configurations belonging to the handheld communicator may be highlighted or otherwise indicated. In some embodiments, the handheld communicator be programmed to provide a user the option to record a name value or an alias for the configuration profile. For example, a technician generating a configuration profile may be able to name the configuration profile as "Mark's Filling Process Temp Sensor **3**." In this embodiment, when the same handheld communicator retrieves a search result for configuration profiles, the communicator may display results that it generated using the user specific values displayed.

Additional data can be indexed to the configuration files based on plant or company organization. This additional data can be adapted to remain internal. For example, a plant or company may decide to encode additional plant specific proprietary metadata into its configuration files which may be used to identify internal plant or company data while still allowing a set of the configuration files to be cloud shared without the metadata, thereby maintaining contributor anonymity. In this manner, non-plant specific data can be shared to the cloud while plant specific data can be retrieved with the encoded equipment device identifiers.

The following additional considerations apply to the foregoing discussion. Throughout this specification, actions described as performed by any device or routine generally refer to actions or processes of a processor manipulating or transforming data according to machine-readable instructions. The machine-readable instructions may be stored on and retrieved from a memory device communicatively coupled to the processor. That is, methods described herein may be embodied by a set of machine-executable instructions stored on a computer readable medium (i.e., on a memory device). The instructions, when executed by one or more processors of a corresponding device (e.g., a server, a user interface device, etc.), cause the processors to execute the method. Where instructions, routines, modules, processes, services, programs, and/or applications are referred to herein as stored or saved on a computer readable memory or on a computer readable medium, the words "stored" and "saved" are intended to exclude transitory signals.

Further, while the terms "operator," "personnel," "person," "user," "technician," and like other terms are used to describe persons in the process plant environment that may use or interact with the systems, apparatus, and methods described herein, these terms are not intended to be limiting. Where a particular term is used in the description, the term is used, in part, because of the traditional activities in which plant personnel engage, but is not intended to limit the personnel that could be engaging in that particular activity.

Additionally, throughout this specification, plural instances may implement components, operations, or structures described as a single instance. Although individual operations of one or more methods are illustrated and described as separate operations, one or more of the individual operations may be performed concurrently, and nothing requires that the operations be performed in the order illustrated. Structures and functionality presented as separate components in example configurations may be implemented as a combined structure or component. Similarly, structures and functionality presented as a single component may be implemented as separate components. These and other variations, modifications, additions, and improvements fall within the scope of the subject matter herein.

Unless specifically stated otherwise, discussions herein using words such as "processing," "computing," "calculating," "determining," "identifying," "presenting," "causing to be presented," "causing to be displayed," "displaying," or the like may refer to actions or processes of a machine (e.g., a computer) that manipulates or transforms data represented as physical (e.g., electronic, magnetic, biological, or optical) quantities within one or more memories (e.g., volatile memory, non-volatile memory, or a combination thereof), registers, or other machine components that receive, store, transmit, or display information.

When implemented in software, any of the applications, services, and engines described herein may be stored in any tangible, non-transitory computer readable memory such as on a magnetic disk, a laser disk, solid state memory device, molecular memory storage device, or other storage medium, in a RAM or ROM of a computer or processor, etc. Although the example systems disclosed herein are disclosed as including, among other components, software and/or firmware executed on hardware, it should be noted that such systems are merely illustrative and should not be considered as limiting. For example, it is contemplated that any or all of these hardware, software, and firmware components could be embodied exclusively in hardware, exclusively in software, or in any combination of hardware and software. Accordingly, persons of ordinary skill in the art will readily appreciate that the examples provided are not the only way to implement such systems.

Thus, while the present invention has been described with reference to specific examples, which are intended to be illustrative only and not to be limiting of the invention, it will be apparent to those of ordinary skill in the art that changes, additions or deletions may be made to the disclosed embodiments without departing from the spirit and scope of the invention.

It should also be understood that, unless a term is expressly defined in this patent using the sentence "As used herein, the term '______' is hereby defined to mean . . . " or a similar sentence, there is no intent to limit the meaning of that term, either expressly or by implication, beyond its plain or ordinary meaning, and such term should not be interpreted to be limited in scope based on any statement made in any section of this patent (other than the language of the claims). To the extent that any term recited in the claims at the end of this patent is referred to in this patent in a manner consistent with a single meaning, that is done for sake of clarity only so as to not confuse the reader, and it is not intended that such claim term be limited, by implication or otherwise, to that single meaning. Finally, unless a claim element is defined by reciting the word "means" and a function without the recital of any structure, it is not intended that the scope of any claim element be interpreted based on the application of 35 U.S.C. § 112(f) and/or pre-AIA 35 U.S.C. § 112, sixth paragraph.

Moreover, although the foregoing text sets forth a detailed description of numerous different embodiments, it should be understood that the scope of the patent is defined by the words of the claims set forth at the end of this patent. The detailed description is to be construed as exemplary only and does not describe every possible embodiment because describing every possible embodiment would be impractical, if not impossible. Numerous alternative embodiments could be implemented, using either current technology or technology developed after the filing date of this patent, which would still fall within the scope of the claims.

What is claimed:

1. A method of sharing plant device configuration data collected by a handheld communicator for a set of process control devices comprising:

communicatively coupling a first handheld communicator to a first process control device to access a set of device parameters of the first process control device;

modifying the set of device parameters of the first process control device using the first handheld communicator;

generating a first configuration profile for the first process control device, wherein the first configuration profile includes a configuration identifier, a device identifier, a set of process control device parameters, and a date-time parameter, wherein a subset of the process control device parameters includes the set of device parameters modified by the first handheld communicator;

assigning a set of relational identifiers including at least one equipment identifier to the first configuration profile, wherein the equipment identifier references at least a second process control device associated with the first process control device; and

querying for the first configuration profile by the device identifier and the at least one equipment identifier to retrieve the first configuration profile.

2. The method of claim **1**, wherein the at least one equipment identifier indexes an equipment profile stored in a memory of the first handheld communicator and wherein the equipment profile includes a device identifier of the second process control device.

3. The method of claim **2**, wherein the at least one equipment identifier is generated by the first handheld communicator to be unique across configuration data collected from multiple plants.

4. The method of claim **1**, further including generating an equipment profile indexed by the at least one equipment identifier, wherein the equipment profile includes an index of related process control devices that includes the first and the second process control device.

5. The method of claim 4, wherein the generating an equipment profile is performed by the first handheld communicator.

6. The method of claim 4, further including executing a process control segment diagnosis by the first handheld communicator and wherein generating the equipment profile is based on devices identified by the segment analysis while the first handheld communicator is coupled to the first process control device.

7. The method of claim 4, further including recording a detected device connection between the first process control device and the second process control device and generating the at least one equipment profile based on the detection, wherein the equipment profile indicates a set of equipment communicatively coupled to the first process control device including the second control device.

8. The method of claim 4, wherein the equipment profile devices are based on user inputs received at the first handheld communicator as part of a configuration process of the first process control device.

9. The method of claim 8, further including prompting a user at the first handheld communicator to confirm whether the first process control device is associated with an equipment profile of another device identifier in a memory of the first handheld communicator.

10. The method of claim 1, wherein assigning a set of relational identifiers includes assigning a process identifier to the configuration profile, wherein the process identifier indexes a process control profile, the process control profile including a set of attributes including at least the process identifier, an equipment profile, and a set of configuration profiles.

11. The method of claim 10, further including prompting a user at the first handheld communicator to confirm whether the first process control device is associated with a process identifier of another device stored in a memory of the first field communicator.

12. The method of claim 10, wherein assigning a set of relational identifiers to the first configuration profile is performed by the first handheld communicator prior to transmitting the first configuration profile to another device.

13. The method of claim 10, wherein the process identifier is manually entered by a user as part of a configuration process.

14. The method of claim 13, wherein the process identifier is indexed to a control loop module identifier.

15. The method of claim 1, wherein generating the first configuration profile includes encoding a plant specific identifier into the configuration identifier and further including displaying a retrieved set of configuration profiles at the first handheld communicator where configuration profiles containing the encoded plant specific identifier are displayed using a local plant alias assigned by the first handheld communicator.

16. A system for sharing plant device configuration data collected by handheld communicators for a plurality of process control devices comprising:

- a first process control device including one of a set of devices including a process controller, an input/output interface, or a field device;
- a first handheld communicator device detachably coupled to the first process control device and adapted to:
  - access a device parameter menu of the first process control device to execute a set of write commands to the first process control device;
  - generate a configuration profile capturing a set of device parameters of the field device, wherein the set of write commands modifies the set of device parameters of the first process control device; and
  - assign an equipment identifier to the configuration profile, wherein the equipment identifier indexes an equipment profile that includes a set of process control devices associated with the field device; and
- a device configuration database adapted to receive the configuration profile from the handheld communicator and to store the configuration profile indexed by at least a device identifier and an equipment identifier.

17. The system of claim 16, further including a second handheld communicator communicatively coupled to a second process control device, wherein the second handheld communicator is further adapted to query for and retrieve the configuration profile from the device configuration database based on the device identifier and the equipment profile and to install the configuration profile on the second process control device.

18. The system of claim 16, further including a second handheld communicator directly coupled to the first handheld communicator and wherein the second handheld communicator is adapted to query for and retrieve the configuration profile by transmitting a request to the first handheld communicator for a list of configuration profiles associated with a device identifier and an equipment identifier.

19. The system of claim 18, further including downloading the queried configuration profile from the first handheld communicator to the second handheld communicator and automatically installing process control device parameters of the configuration profile to a second process control device communicatively coupled to the second handheld communicator.

20. The system of claim 16, wherein the handheld communicator is further adapted to assign a process identifier to the configuration profile.

21. The system of claim 16, wherein the handheld communicator is further adapted to encode a plant specific identifier into the configuration identifier.

22. The system of claim 21, wherein the handheld communicator is further adapted to recognize the plant specific identifier and to display an alias value when the configuration profile is retrieved by the handheld communicator in lieu of a default configuration identifier value.

23. The system of claim 16, wherein the device configuration database is hosted by a cloud server.

24. The system of claim 23, further including a plant workstation communicatively coupled to the device configuration database and the cloud server and adapted to recognize plant encoded configuration identifiers and to forward the configuration profile to the cloud server after removing the plant specific encoding in the configuration identifiers.

25. A computing device for use in configuring a plant device comprising:

- a computer readable memory;
- a processor;
- a first interface communicatively connected to a first process control device, wherein the first interface is detachable from the first process control device,
- wherein a configuration application is stored on the computer readable memory and adapted to be executed on the processor to:
  - communicate with the first process control device via the first interface to access a set of device parameters of the first process control device;

modify the set of device parameters of the first process control device;

generate a first configuration profile for the first process control device, wherein the first configuration profile includes a configuration identifier, a device identifier, a set of process control device parameters, and a date-time parameter, wherein a subset of the process control device parameters includes the set of device parameters modified by the configuration application;

assign at least one equipment identifier to the first configuration profile, wherein the equipment identifier references at least a second process control device associated with the first process control device; and

query for the first configuration profile by the device identifier and the at least one equipment identifier to retrieve the first configuration profile.

26. The computing device of claim **25**, wherein the configuration application is further adapted to assign a process identifier to the first configuration profile, wherein the process identifier indexes a process control profile, the process control profile including a set of attributes including the process identifier, an equipment profile, and a set of configuration profiles.

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